Amendments to the Drawings

The attached replacement sheet of drawings shows a change to Fig. 1 by the addition of the numeral 28 to indicate a blow-off hole.

ATTACHMENT:

REPLACEMENT SHEET

REMARKS

Priority under 35 USC §119

It is respectfully requested that the claim for priority be acknowledged.

Specification and Abstract

The Specification has been amended on page 5 simply to identify the blow-off hole 28 with a numeral. The blow-off hole is specifically claimed in the claims and therefore should be designated by a numeral. The blow-off hole is specifically described in the Specification at page 3 line 9.

The Abstract has been amended to improve its form.

Amendments to the Drawings

Fig. 1 of the drawings has been amended to identify the blow-off hole with the numeral 28. It is respectfully requested that this amendment be approved since the blow-off hole is originally described in the Specification at page 3, line 9 but was not designated with a specific numeral.

Claim Rejections Under 35 USC §112 and Claim Objections

Claims 1, 10 and 19 stand rejected under 35 USC 112, second paragraph, as being indefinite for the various reasons set forth in paragraph 1-5 in page of the Action.

Claims 1 and 10 have been amended to delete "characterized by comprising" and claims 1, 10 and 19 have been amended to clarify the previous limitation "an air flow path formed between outside air and a substantially airtight state".

Method claim 19 has also been amended to clarify the phrase "comprising the step of" referred to in paragraph 5 on page 2 of the Action.

It is submitted that the claims now satisfy all the requirements of 35 USC 112.

Claims 1 and 10 stand objected to because of informalities in referring to "a nozzle" in claim 1 and "a turbine nozzle" in claim 10. Claims 1 and 10 have been amended in a manner in which it is believed satisfies the Examiner's objections.

Claims Rejections Under 35 USC §102(b) and 35 USC §103(a)

Claims 1-3, 5, 7, 10-12, 14, 19 and 20 stand rejected under 35 USC 102(b) as being anticipated by Shekleton, U.S. Patent No. 4, 825,640 and claims 1, 4, 10, 13 and 19 stand rejected as being anticipated by Corrado, U.S. Patent No. 5,280,703.

Claims 9 and 18 and stand rejected under 35 USC 103(a) as being unpatentable over Corrado in view of Noe Pub. No. 2003-0031555.

For the reasons set forth hereafter, it is submitted that the claims, as amended patentably distinguish over the prior art.

Patentability of the Claims

Independent claims 1, 10 and 19 have been amended to further define the radial turbine and the method of cooling a nozzle thereof as including through holes extending through the shell of the turbine from an air flow path on both sides of the nozzle adjacent a front edge of the nozzle and the through holes as being inclined at an angle toward a direction of flow of the combustion gas to inject a second part of the air taken into the air flow path into the combustion gas passing through the nozzle.

Further amendments have been made to the claims to more specifically define Applicant's invention. Thus, the claims now specify the positions of the combustor outer cylinder 8 and the combustor liner 9 in order to make it clear that the compressed air 20 is fed to the combustor outer cylinder 8 and then into the combustor liner 9 after cooling the entire scroll in the casing 7. The compressed air 20 is divided into the nozzle cooling compressed air 23 and the compressed air to be fed to the combustor within the casing. The nozzle cooling air 23 bypasses the combustor liner 9 and therefore does not cool the combustor liner 9, and does not exchange heat directly with the liner 9. See Fig. 1 and the Specification at page 6, line 19 to page 7, line 17.

As now claimed, Applicant's invention relates to a radial turbine comprised of an outer casing, a scroll mounted inside the outer casing which forms a first part of a combustion gas flow path for guiding a combustion gas generated in a combustion to a nozzle which injects the combustion gas to a radial impeller on an inner side in a radial direction of a rotary shaft. A combustor outer cylinder is mounted outside of the outer casing and a combustor liner is mounted inside the outer cylinder. The liner is communicated with the scroll and guides the combustion gas into the scroll. The turbine further includes a shell which covers the nozzle and the impeller and forms a second part of the combustion flow path. An airtight air flow path is formed inside the casing and an air take-in hole is provided which takes in air into the air flow path from the outside. A blow-off hole guides the first part of the air taken into the air flow path into the combustor. Finally, through holes are provided extending through the shell from the air flow path on both sides of the nozzle adjacent a front edge of the nozzle and which are inclined at an angle toward a direction of flow of

the combustion gas to inject a second part of the air taken into the air flow path into the combustion gas passing through the nozzle.

This construction is not shown by the prior art, particularly the through holes extending through the shell from the air flow path on both sides of the nozzle adjacent a front edge of the nozzle and inclined at an angle toward a direction of flow of the combustion gas.

The Shekleton '640 patent relates to a radial gas turbine having a plurality of through holes 134 in an outer wall 76 which permit a part of the air taken into an air flow path to impinge upon turbine nozzle blades 136 to cool the blades. As shown in Figs. 1 and 3 of Shekleton, however, the through holes 134 are located a significant distance from the nozzle 46. Therefore a cooling effect on a blade surface is substantially diminished. Although Shekleton states in column 7, beginning at line 46 that the air coming in is not appreciably mixed with the combustion gases, the mixture of the air with the combustion gases cannot be avoided because of the structure wherein the through holes are located a significant distance from the nozzles and the point where the combustion gas 46 flows into the nozzles 46. As a result, the cooling effect of Shekleton is substantially diminished and the efficiency of the turbine is decreased due to a decrease in the temperature of the combustion gas.

Moreover, in Shekleton, the incoming air entering through the holes 134 only comes from one side of the nozzle. Therefore, even if the through-holes 134 of Shekleton are moved to a position near the front edge of the nozzle, and imbalance of temperature distribution between the left side and the right side of the nozzle is caused since the cooling air is introduced from the left side of the nozzle 46 while the

right side of the nozzle is adjacent to the combustor 38. This results in deformation of the nozzle and the like due to thermal stress and causes a derogation of the reliability of the turbine.

In the present invention, the through holes 51 are provided in a position adjacent the front edge of the nozzles 2 and extend through the shell 5 from the air flow path on both sides of the nozzle and are inclined at an angle toward a direction of flow of the combustion gas to inject a part of the air taken into the air flow path into the combustion gas passing through the nozzle. Since the through holes 51 are provided on both right and left sides of the turbine shell as shown in the side sectional view of Fig. 1 (B) to inject the compression air with the same temperature from both the right and left sides, cooling is achieved without any imbalance of temperature distribution on the nozzle. This is a significant advantage over the prior art.

The Corrado '703 patent discloses a radial gas turbine which suffers from the same deficiencies as that described with respect to Shekleton. Thus, as shown in Fig. 1 of the Corrado patent, incoming air goes through a channel 58 through an opening 54 on the right hand side of the nozzle 40 and initially cools only the right hand side of the nozzle. On the other hand, the remaining part of the incoming air circulates around the combustion chamber whereby it has been warmed by the time it reaches the vicinity of the left hand side of the nozzle 40. Accordingly, a temperature differential is created between the right and left sides of the nozzle with the right side being cooler than the left side. This results in an imbalance of the temperature distribution which causes deformation of the nozzle due to thermal stress.

By contrast, in the present invention it is possible to inject incoming air having the same temperature from both the left and right hand sides of the nozzle and to therefore suppress generation of thermal stress.

The Noe publication was cited as teaching a plurality of shell through-holes along a surface of each blade of a circular blade cascade wherein the through holes tilt in a flowing direction of the combustion gas flow path. Accordingly, Noe does not teach injecting the air with the same temperature from both left and right sides of a nozzle as in Applicants' invention.

Accordingly, it is submitted that Applicants' invention, as now claimed, patentably distinguishes over the cited references, taken either alone or in combination.

CONCLUSION

In view of the foregoing amendments and remarks, Applicants contend that the above-identified application is now in condition for allowance. Accordingly, reconsideration and reexamination are respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, or credit any overpayment of fees, to the deposit account of Mattingly, Stanger, Malur & Brundidge, P.C., Deposit Account No. 50-1417 (referencing attorney docket no. ASA-5487).

Respectfully submitted,

MATTINGLY, STANGER, MALUR & BRUNDIDGE, P.C.

Gene W. Stockman
Registration No. 21,021
(703) 684-1120

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